DRAFT

MEDIUM INTENSITY AIRPORT WEATHER SYSTEM (MIAWS)

STATEMENT OF WORK

April 6, 2001

1.0 OVERVIEW

The Statement of Work (SOW) includes provisions for program management, systems engineering, configuration management, quality assurance, system test and evaluation, delivery, and installation for one Medium Intensity Airport Weather System (MIAWS). The MIAWS will provide timely and accurate weather information at medium-intensity airports that do not have a Terminal Doppler Weather Radar (TDWR) or Weather Systems Processor (WSP).

1.1 Background

Medium intensity airports, which are defined by the number of Air Traffic Control (ATC) operations conducted and the number of hazardous weather days experienced, have typically been provided with limited weather detection and alert capabilities, such as Low Level Wind Shear Alert System (LLWAS). While providing wind shear warnings, LLWAS does not provide ATC with a display of precipitation or storm motion and predicted storm track. High-intensity airports have received the Integrated Terminal Weather System (ITWS), Terminal Doppler Weather Radar (TDWR) or Weather Systems Processor (WSP) systems, which are technically advanced and costly weather display systems. Medium intensity airports fall short of the operational threshold used to designate high-intensity airports but still need displayed weather data. Using available weather data, MIAWS would provide enhanced capabilities to medium-intensity Air Traffic Control Towers (ATCTs) and at significantly less cost than the systems at high-intensity airports.

1.2 Program Objective

The Federal Aviation Administration (FAA) has established a need, as stated in the ITWS Mission Need Statement (MNS) 234, for weather detection, display of precipitation intensity, and real-time storm motion with projected position at ATCT facilities. This capability will be used to alert ATC to the severity, location, movement, and expected duration of hazardous weather events. Weather occurring in and around airport operational areas has had a significant negative impact on safety and efficiency of aircraft operations.

2.0 APPLICABLE DOCUMENTS

The following specifications, handbooks, orders, standards, and drawings form a part of this SOW and are applicable to the extent specified herein. The latest version of these documents as of the contract date shall apply. In the event of conflict between this SOW and any of the applicable documents cited below, the provisions of this SOW shall apply unless otherwise modified and agreed upon by the Contractor and the Government.

a. Copies of FAA documents and other applicable FAA specifications, standards, directives, advisory circulars, NAS documents, drawings, and interface documents may be obtained from the Contracting Officer in the FAA office issuing the Screening Information Request (SIR). Requests should fully identify the material desired. Request should also cite the SIR or the contract involved or other use to be made of the requested material.

b. Copies of military standards and specifications may be ordered by mail or telephone from the Department of Defense Automated Printing Service, Building 4/Section D, 700 Robbins Avenue, Philadelphia, PA 19111-5094, (215) 697-2179/4107, 7:30 AM to 4:00 PM, Monday through Friday. Information is also available at their website, http://www.astimage.daps.dla.mil/online. A charge is made for each document ordered.

c. Copies of ANSI/ISO/ASQ documents may be obtained from the American Society for Quality Control, 611 East Wisconsin Avenue, P.O. Box 3005; Milwaukee, WI 53201-3005, (414) 272-8575 or (800) 248-1946. The Fax number is: (414) 272-1734.

d. IEEE documents may be ordered from IEEE, 445 Hoes Lane, P.O. Box 1331, Piscataway, NJ 08855-1331, (800) 678-IEEE. Documents may also be ordered via the IEEE website, http://www.ieee.org/prod_svcs.html.

e. Requests for copies of documents not covered in the preceding paragraphs, should be addressed to the Contracting Officer (CO). Requests should fully identify material desired and cite the solicitation or contract number.

f. Some Data Item Descriptions (DID) may be available under the FAA Acquisition System Toolset (FAST) website, http://fast.faa.gov. From the home page, select Toolsets, then Procurement Toolbox, and from the Statement of Work Generator, establish a login id and password, and then select the DID library. The Acquisition Management System Test and Evaluation Process Guidelines may be found on the FAST website.

2.1 Military Standards and Specifications

MIL-STD-129	Marking for Shipment and Storage

2.2 FAA Documents

FAA-BCATS-96-001	Bar Code Asset Serial Number Symbology, Quality and Format Specifications
FAA-E-2950	MIAWS Specification
FAA-G-2100	Electronic Equipment, General Requirements
FAA Order 1050.17	Airway Facilities Environmental and Safety Compliance Program
FAA Order 1370.82	Information Systems Security Program
FAA Order 1600.1	Personnel Security Program
FAA Order 1600.69	Facility Security Risk Management Program
FAA Order 1800.58	National Airspace Integrated Logistics Support Policy
FAA Order 1800.66	Configuration Management Policy

FAA Order 3900.19	Occupational Health and Safety
FAA Order 8040.4	Safety Risk Management
FAA Order 9550.8	Human Factors Policy
FAA-STD-021	Configuration Management Contractor Requirements
FAA-STD-025	Preparation of Interface Control Documentation
FAA-STD-026	NAS Software Development
FAA Unnumbered	Acquisition Management System Test and Evaluation Process Guidelines
FAA Unnumbered	Human Factors Job Aid

2.3 Other Publications and Specifications

ANSI/ISO/ASQC Q9001-1994	American National Standard, Quality System-Model for Quality Assurance in Design, Development, Production, Installation, and Servicing
ANSI/ISO/ASQ Q9000-3-1997	Quality Management and Quality Assurance Standards - Part 3:Guidelines for the Application of ANSI/ISO/ASQ 9001-1994 to the Development, Supply, Installation and Maintenance of Software
DOT H 1350	Information Systems Security Guide
DOT H 1350.251	Network Security Guide
IEEE/EIA 12207	Industry Implementation of International Standard ISO/IEC: ISO/IEC12207 Standard for Information Technology Software life cycle processes, paragraphs 5.3, 6.2 and 6.3.
IEEE Standard 830-1998	Recommended Practice for Software Requirements Specifications, Sections 5, 6 and Annex A.
IEEE Standard 1016-1998	Recommended Practice for Software Design Descriptions
OMB Circular A-130	Management of Federal Information Resources
OSHA	29 Code of Federal Regulations (CFR) 1910 - Occupational Safety and Health Standards
OSHA	29 CFR 1925 - Safety and Health Standards for Federal Service Contracts
Presidential Decision Directive 63	Critical Infrastructure Protection

3.0 SYSTEM REQUIREMENTS

The Contractor shall produce one MIAWS such that all requirements in this SOW and the MIAWS Specification (FAA-E-2950) are satisfied.

The Contractor shall produce, integrate, test, deliver, install, checkout, and adapt the MIAWS. The system shall include all hardware, software, firmware, interfaces, commercial and non-commercial licenses, special support and test equipment, and any equipment required for delivery installation, integration, and checkout.

The Contractor shall, to the maximum extent possible, use non-developmental items (NDI) for MIAWS. For the purposes of this Contract, NDI is defined as: 1) any commercial off-the-shelf (COTS) item; or 2) any previously developed product in use by a Federal, state, or local Government agency of the United States or a foreign government. A COTS item is any product which has been developed independently by industry to meet market demand. (This includes newly developed items that do not yet have a market history.)

The Government will provide the Contractor, as Government Furnished Information (GFI) (as is), a hardcopy and electronic version of the Massachusetts Institute of Technology/Lincoln Laboratory (MIT/LL) MIAWS prototype software. The algorithms and the display presentations will be provided as Government Furnished Property (GFP) and shall not be modified by the Contractor without the Government's consent. The Contractor may use all or part of the GFI software to satisfy the MIAWS requirements in FAA-E-2950 and this SOW. The Government does not encourage nor discourage the use of the MIT/LL software. The correctness of algorithm implementation and display presentations shall be subject to testing and verification as part of Factory Acceptance Testing (FAT) with formal Government approval required. MIT/LL personnel will be made available to the Contractor on request to answer questions regarding the prototype design and software.

3.1 Program Management

The Contractor shall submit for Government approval a Program Management Plan (PMP), and shall revise such plan as necessary. Upon approval of the PMP, the Contractor shall conduct all MIAWS program activities in accordance with (IAW) this plan. The PMP shall identify the Contractor's management, organization, authority, responsibility and controls, and the extent to which these apply to the MIAWS system. The PMP shall detail the Contractor's methodology to ensure that the program management requirements set forth in this SOW are met. At a minimum, the Contractor shall perform the following tasks in managing the MIAWS Contract:

a. Produce the schedules of work that reflect and track the delivery of products as specified by this SOW and the Government provided Work Breakdown Structure (WBS). (Attachment TBD.)

b. Use methods and metrics for assessing the schedule, technical performance of the work, and risks of this program.

c. Use procedures for relating risks and costs to schedule and technical performance to assess the impact of risks and costs on successful completion of the MIAWS work efforts.

d. Designate a Program Manager (PM) who is responsible for integrating and maintaining the total Contractor effort as described in this SOW. The PM shall be prepared at all times, given reasonable notice, to present and discuss with the FAA the status of contract activities.

An integral factor in the success of the MIAWS Contract is the Contractor's plans for interaction with the Government. The PMP shall include the Contractor's plan for ensuring that all interaction is managed and conducted to provide maximum benefit toward successful completion of the MIAWS contract.

CDRL: A001 Program Management Plan

3.1.1 Project Control

The Contractor shall continuously monitor the technical performance of this contract, and of all subcontracts to provide the Government with a timely assessment of program progress and problems, and to control the contract activities as well as subcontractor and vendor activities. The Contractor shall utilize the Baseline Master Integrated Project Schedule presented in the FAA-approved PMP and the Government provided WBS to maintain a logical and efficient sequence of events designed to accomplish the tasks described in this contract. The schedule shall include both planned dates and actual completion dates.

The Contractor shall provide the current status including the technical, cost, and schedule of the design, development, fabrication, and test efforts in the Contractor prepared Project Status Report (PSR). Costs shall be reported IAW the Government-provided WBS. The Contractor's management methods and procedures shall ensure that the Contractor provide visibility into, and timely progress reporting on, all contracted efforts for internal management and Government oversight purposes.

The Contractor shall provide a status of all action items in the PSR.

The Contractor shall conduct ongoing risk management activities during the period of the contract and shall address risks in the PSR.

CDRL: A002 Project Status Report

3.1.2 Data Management

The Contractor shall establish a data management program to maintain: contractually required documentation and correspondence; design, test, and production documentation; and other supporting documentation. This shall be done in one logical and inclusive system using ISO 9001/9000-3 Section 4.5 Documentation and Data Control as guidance. This effort shall include documentation involved with, but not limited to, the development, implementation, testing, schedule, and management of the equipment. This specifically shall include a process for monitoring, reporting, status accounting, and cross-matrixing of changes to, additions of, or deletions of

data item deliverable contents. All data items shall be configuration-managed by the Contractor.

The Contractor shall identify a single focal point for integrating and maintaining the total Contractor data management effort. When requested by the Government, the Contractor shall make available, for Government review, the internal documents used to design and manage the program.

3.1.2.1 Data Items

Data items referenced by their Contract Data Requirements List (CDRL) titles are to be performed IAW the CDRL of the same name, even when the CDRL number is not specified. All data deliverables shall be prepared and delivered IAW the corresponding CDRL items specified under the SOW requirement. One hard copy of each deliverable shall be delivered to AND-420. A cover letter for each deliverable shall be delivered to ASU-320.

The Contractor shall make all deliverable documents available on a website and provide password protected Internet access to CDRLs. When a deliverable document is posted on the website, the Contractor shall notify each organization in block 14 on the 1423. The Government will provide a list of lead reviewers for each document. If a deliverable is not printable, hard copies shall be delivered to every organization in block 14 on the 1423 sheet for that deliverable.

The Government will review all CDRL items to verify Contractor compliance with the system requirements specified herein and in FAA-E-2950. The Contractor shall identify and use an orderly review and comment process in order to prevent schedule delays. The Contractor shall track all document revisions and shall submit revised documents with revision marks. Revision marks shall be removed in the final delivery of documents unless otherwise stated. All documents shall be configuration managed.

The Contractor shall perform IAW all plans developed in response to the CDRLs specified in this SOW and as approved by the Government. All reference to the "Government" in this SOW shall mean by authority of the CO or designee. All CDRL items identified in this SOW shall be delivered to the Government, if possible, in digital media compatible with the Microsoft Office suite of products, version 97/2000, or .pdf format as well as hard copy unless superceded by specific DID instructions.

Government response to all CDRLs will be 30 calendar days from the Government’s receipt of the CDRL, unless otherwise noted in the CDRL form. Contractor response shall be 30 calendar days from the receipt of the Government’s comments unless otherwise noted in the CDRL form. All references to days in the 1423 forms shall be calendar days unless otherwise noted.

3.1.3 Meetings, Program Reviews and Conferences

The Contractor shall conduct meetings and reviews IAW this SOW. At each management review or technical review, the Contractor shall provide backup data regarding assumptions made and methodologies used in arriving at specific recommendations or conclusions. The Contractor shall prepare and submit a meeting agenda, meeting minutes, and presentation materials for all meetings.

The minutes, accompanied by a summary of action items and all presentation materials used, shall be provided by the Contractor for Government approval. Management and technical reviews shall not be considered complete until approval by the Government is granted in writing. The Contractor shall propose an overall strategy for conducting each set of reviews.

Meeting support provided by the Contractor shall include, but is not limited to, facilities, materials, office equipment, clerical personnel, technical data, and subcontractor participation (when requested by the Government).

CDRL: A003 Agenda
CDRL: A004 Presentation Materials
CDRL: A005 Meeting Minutes

3.1.3.1 Post Award Conference

The Contractor shall plan for, host, support, and participate in a Post Award Conference to be held at the Contractor's site within one month after contract award. The FAA will determine the specific date within two (2) weeks after contract award. At this conference, the Contractor shall address the plans and schedules for the MIAWS work efforts.

CDRL: A004 Presentation Materials
CDRL: A005 Meeting Minutes

3.1.3.2 Program Management Reviews

The Contractor shall support Program Management Reviews (PMRs) as specified in the Government approved PMP. PMRs shall be held quarterly, alternating between the Contractor’s facility and sites selected by the Government. During the PMRs, the Contractor shall review plans for accomplishing project milestones. The PMR shall include, but not be limited to:

a. Cost, schedule, and technical performance status of the contract (summary staffing and cost reporting to Level 2 of the WBS and detailed reporting to Level 3 of the WBS), including specific coverage of problem areas and any known or anticipated differences between the current contract milestones, schedules, or technical performance parameters and those included in the Government approved PMP;

b. Accomplishments since the last PMR;

c. Expected accomplishments prior to the next PMR;

d. Schedule critical paths;

e. Definition and implementation of contingency or work-around plans;

f. Program risks and status of risk-alleviation measures;

g. Software/hardware design, code, fabrication, and test status, including the status of Program Trouble Reports (PTRs), which are included in the PSRs;

h. Status of action items, CDRL deliveries, GFP/Government Furnished Equipment (GFE), and Government/Contractor correspondence;

i. Cost/schedule performance.

CDRL: A003 Agenda
CDRL: A004 Presentation Materials
CDRL: A005 Meeting Minutes

3.2 Systems Engineering and Design Development

The Contractor shall execute a systems engineering program for the definition, development, integration, and testing of the MIAWS requirements. Systems engineering efforts shall consider all aspects of performance, quality, life cycle cost, maintainability, reliability, schedule, data processing reserves, and future growth requirements.

MIAWS shall allow improvements to hardware and software elements without requiring a change to other system components or architecture.

Prior to contract award, the Government will establish a baseline version of MIT/LL's prototype software to be provided to the Contractor. If the Contractor identifies a problem with the software, the Contractor shall immediately notify the Government. If the Government identifies a problem with the software, the Government will immediately notify the Contractor. The Contractor shall maintain a database of prototype software discrepancies identified by the Contractor and the Government. The Contractor shall provide the prototype software discrepancies database as a part of electronic on-line access to authorized FAA personnel (read only mode).

Within one month after contract award, the Government will present a detailed system familiarization to the Contractor so that the Contractor understands MIT/LL's prototype functionality and interfaces.

The Contractor shall perform hardware prototyping as necessary to support system design development, and shall designate and purchase, with Government approval, prior to Critical Design Review (CDR), long lead-time hardware items necessary to implement the system design.

The Contractor shall maintain effective control over the systems engineering and design development process, including subcontract items and services, to ensure that cost, performance, and schedule are met, to provide early detection of problems, and to reduce risk. The Contractor shall specify a single authority that will serve as Point of Contact for systems engineering tasks.

3.2.1 Systems Engineering Management Plan

The Contractor shall develop a Systems Engineering Management Plan (SEMP), as part of the PMP (CDRL A001), that describes the Contractor’s practices and procedures for functional analysis, the process for generating derived requirements, requirements allocation, traceability of requirements, and synthesis. The SEMP shall describe what trade studies shall be conducted and what systems engineering tools shall be used. The SEMP shall also cover

design optimization analysis, interface compatibility analysis, and a producibility analysis.

CDRL: A001 Program Management Plan

3.2.2 Systems Engineering Documentation

The Contractor shall provide the following engineering documents.

3.2.2.1 System Design Description

The Contractor shall provide a System Design Description (SDD) that describes the break-out of the MIAWS specification (FAA-E-2950) requirements into Hardware Configuration Items (HWCIs) and Computer Software Configuration Items (CSCIs) and shall provide traceability back to the GFE Test Verification Requirements Traceability Matrix (TVRTM). The SDD shall describe the system architectural design, the system design concept of execution, the system interface design, and decisions about the selection and design of system components. The SDD shall contain an explicit trace of each system requirement in the MIAWS specification (FAA-E-2950) to the Configuration Item (CI) to which it is allocated by the Contractor. The Contractor shall provide a detailed design of the MIAWS hardware as part of the SDD.

The Contractor shall propose site adjustable parameters IAW FAA-E-2950 for the MIAWS and document them in the SDD. The proposed site adjustable parameters shall be approved by the Government prior to their implementation.

CDRL: B001 System Design Description

3.2.2.2 Interfaces

MIAWS shall have the capability to be integrated with other NAS and non-NAS elements without degradation of operational systems, subsystems, networks, and facilities.

3.2.2.2.1 Interface Control Documentation

The Contractor shall develop interface control documents (ICDs), as listed in Table 1, based on an analysis and break-out of the requirements contained in the MIAWS specification (FAA-E-2950). The Contractor shall submit ICDs using FAA-STD-025 as guidance to the Government for review and approval.

Interface controls shall be established, coordinated, and maintained for interface requirements and documents, and include applicable Contractor, subcontractor, and vendor contract items, and GFP/GFE/GFI computer programs, facilities, and data. The Contractor shall define MIAWS interface requirements as a part of the systems engineering process.

Table 1 Interface Control Documentation

No	Name of ICD	Sources	CDRL
1	MIAWS/NEXRAD	*Contractor*	B002
2	MIAWS/LLWAS-II	*Contractor*	B002

3	LLWAS/RS	*Contractor*	B002

CDRL: B002 Interface Control Document

3.2.3 Software

The Contractor shall acquire/develop, document, integrate, and test all system software provided or developed under this contract.

The Contractor shall permit authorized FAA personnel or designees to inspect all software documentation, including any source code. The Contractor shall make available to the FAA for review, the information, practices, procedures, and/or documentation developed/acquired by the Contractor or its subcontractors in conjunction with the MIAWS program.

The Contractor shall allow the FAA to informally witness any CI test associated with the software development and/or integration. The Contractor shall permit authorized FAA personnel or designees to formally audit any aspect of its software development process. The Government will notify the Contractor at least 5 working days before the start of the test the Government would like to witness. Any witnessing will be done on a non-interference basis. No special documentation shall be required. The Contractor shall set test schedules.

3.2.3.1 Software Engineering Practices

The Contractor shall use IEEE/EIA 12207 paragraphs 5.3, 6.2 and 6.3 as guidance in establishing a software development process.

3.2.3.2 Programming Languages

A single, high-order, ANSI-standardized (or other government-approved) language shall be used for programming all MIAWS product generation software. The Contractor shall obtain prior Government approval to use assembly language for new development. The Government will approve the use of assembly language only when the Contractor shows, to the satisfaction of the Government, that the use of assembly language is required to meet performance requirements.

3.2.3.3 Software Development Plan

The Contractor shall prepare, apply, and maintain a Software Development Plan (SDP). The SDP shall describe the Contractor’s plans for conducting the MIAWS software development effort. The SDP shall be written IAW CDRL B003.

CDRL: B003 Software Development Plan

3.2.3.4 System Software Design

Computer programs and/or microprograms that are loaded in a class of memory [Programmable Read Only Memory (PROM) or writeable control store] that cannot be dynamically modified by the system or a computer during processing shall be considered firmware. All firmware shall be treated as software. For purposes

of this contract, programmable logic devices shall also be considered software and the requirements herein shall apply.

Documentation of such memory shall be included in the SDD. Related computer programs or microprogram(s) shall be provided with appropriate documentation for their understanding, implementation and modification. Contractor-developed firmware in this effort shall not reside in masked-programmed ROM's. Instructions on procedures required to replace and/or modify firmware elements shall be provided.

Application software shall be designed for an industry-standard operating system. MIAWS software shall be IAW the manufacturer recommendations of the operating system and COTS applications and applicable industry standards to assure compatibility with future releases of the operating system and related COTS software applications. The Contractor shall implement updates and revisions as they occur until the Test Readiness Review (TRR). If the Contractor has a desire to modify commercial software, the Contractor shall provide justification for the change to the Government. The justification shall state the method of documentation. All changes shall require Government approval.

For standard commercial software employed to satisfy MIAWS requirements, corresponding commercial documentation, licensing agreements, and usage limitations shall be submitted to the Government for approval. The Contractor shall ensure that the Government has the unrestricted access to additional copies of commercial software documentation.

3.2.3.5 Software Documentation

The Contractor shall provide the documentation for requirements, design, test, quality assurance, delivery, installation, and support of each computer resource CI and CSCI whether the software is Contractor-developed, GFI, COTS, or NDI software. The Contractor may choose to use MIT/LL documentation as part of the delivered software documentation. However, all delivered software documentation shall meet the requirements specified in the following paragraphs. The Contractor shall submit software documentation to the Government for review and approval. The following sub-paragraphs are the tailored list of software documentation.

3.2.3.5.1 Software Requirements Specification

The Contractor shall develop a Software Requirements Specification (SRS) for each computer program configuration item (CPCI) and shall submit the same to the Government for authentication. The SRS shall satisfy the requirements of IEEE Standard 830-1998.

The SRS shall document and allocate each requirement in the SDD applicable to the software. The SRS shall provide a complete allocation matrix of all software requirements (explicit and derived) from the SDD. The Contractor shall provide traceability of the SRS allocation matrix back to the GFE TVRTM. The SRS shall also contain a cross-matrix tracing each SRS requirement to its MIAWS (or subsystem) requirement. The SRS shall identify external and internal interfaces (i.e., outward and downward links). It shall contain

estimates of timing and sizing requirements. Following delivery to the Government, the SRS shall be subject to configuration control.

CDRL: B004 Software Requirements Specification

3.2.3.5.2 Software Design Description

The Contractor shall develop a Software Design Description (SoDD) document for each CPCI documented by an SRS and shall submit the same to the Government for authentication. The SoDD shall satisfy the requirements of IEEE Standard 1016-1998, Sections 5, 6 and Annex A. Detailed design descriptions, including input and output definitions, shall be located in headers of code modules to the maximum extent practical. The SoDD shall also contain a detailed description of the component interfaces between newly developed software/firmware components and COTS, NDI, or proprietary components.

For all software provided under the contract associated with this SOW (developed, GFI, COTS, and NDI), the Contractor shall provide a SoDD for each CSCI. The SoDD shall describe the architectural design of the CSCI (identify software units, interfaces, and the concept of execution (among them)) plus the allocation of requirements from a CSCI to its Computer Software Units. The SoDD shall be subject to formal configuration control and shall not be changed without prior Government approval.

CDRL: B005 Software Design Description

3.2.3.6 Software Development Tools

The Contractor shall provide all commercial, non-commercial, developed/modified, non-operational, software development, simulation, test, maintenance, and support tools. Documentation of non-operational software shall be included in the SoDD.

CDRL: B006 Software Development/Support Tools

3.2.3.7 Source Code

The Contractor shall provide source code for all MIAWS operational, support (including developmental tools), and test software including source code listings and build instructions (if any). All code (whether Contractor-developed, GFI, COTS, or NDI) shall be adequately documented for maintenance by a third party. The Contractor shall also provide all software programs used to develop required test data, technical design data, or documentation data. Software development files shall be included. In addition, the Contractor shall provide all software programs necessary to load, analyze, modify, reassemble, and reproduce the system's executable software and/or firmware.

Source code listings and object code for all Contractor-developed software shall be provided on CD ROM IAW the SDP.

CDRL: B007 Source Code

3.2.4 Hardware Identification and Selection

The Contractor shall procure/develop/manufacture, integrate, and test all hardware provided or developed under this contract. The Contractor shall employ best commercial practices as guidance for all hardware design.

The Contractor shall provide a detailed design of the MIAWS hardware as part of the SDD. This design and development shall be IAW, and meet the requirements of, the MIAWS specification (FAA-E-2950). The Contractor shall make maximum use of readily available COTS hardware systems that satisfy the functional and performance requirements of the MIAWS specification (FAA-E-2950). Hardware subsystems, assemblies, or components that meet the requirements of the entire MIAWS specification (FAA-E-2950) shall be procured according to applicable FAA regulations and orders.

CDRL: B001 System Design Description

3.2.4.1 Service Life

The MIAWS shall support continuous, round-the-clock operation. The MIAWS shall continue to meet the functional and performance requirements of specification (FAA-E-2950) throughout a service life of at least 20 years.

3.2.4.2 Obsolete Parts Replacement

The Contractor shall develop/identify form, fit, and function replacements for parts which become obsolete. Government approval shall be required before procurement of replacement parts.

3.2.5 Access to System Development Environment

The Contractor shall fully cooperate and provide the FAA full and timely access to the MIAWS development environment. Such access shall include, but not be limited to, data, documentation, draft CDRLs, source code, and the physical plant. FAA access shall include access for FAA employees and FAA Contractor support personnel. FAA access shall also include FAA Training Academy personnel in support of their development of Airway Facilities training. To facilitate such access, the Contractor shall:

a. Provide the FAA with weekly physical access of not less than forty (40) hours.

b. Provide access to contract deliverables prior to delivery.

c. Provide the FAA with electronic access to data, documentation, and MIAWS development environment elements, other than physical plant facilities.

d. Propose an alternative method to providing access, where remote electronic access is not feasible, subject to acceptance and approval by the Government.

e. Provide timely notification to the Government of any adverse impact to the development effort arising from the cooperation and access afforded to the FAA as specified herein.

3.2.6 Reliability Program

The Contractor shall maintain a reliability program to ensure that the reliability requirements of specification (FAA-E-2950) and this SOW are satisfied. The Contractor shall act as a focal point for tracking failed hardware and software. Part of this effort shall include using the associated failure data as part of the Contractor’s reliability program. The Contractor shall analyze failures, and present failure data and discuss engineering remedies/actions at Technical Interchange Meetings (TIMs) and PMRs. The Contractor's overall methodology for conducting a reliability program, including the process(es) for tracking failed hardware and using the failure data for reliability purposes, shall be documented in a Reliability Program/Demonstration Plan. The Contractor shall submit reliability documentation IAW the CDRLs.

CDRL: D001 Reliability Program/Demonstration Plan
CDRL: D002 Reliability Predictions/Demonstration Report

3.2.7 Maintainability Program

The Contractor shall maintain and demonstrate a maintainability program to ensure that the maintainability requirements of the MIAWS Specification (FAA-E-2950) and this SOW are satisfied. The Contractor's overall methodology for conducting a maintainability program shall be documented in a Maintainability Program Demonstration Plan. The Contractor shall submit maintainability documentation IAW the CDRLs.

CDRL: D003 Maintainability Program/Demonstration Plan
CDRL: D004 Maintainability Demonstration Procedures
CDRL: D005 Maintainability Predictions/Demonstration Report

3.2.8 Reliability and Maintainability Analysis and Predictions

The Contractor shall provide information on the reliability and maintainability of MIAWS components at the CDR. Procedures used to establish this information shall conform to methods described in appropriate MIL-HDBK-217 or other applicable standards (Bellcore method).

3.2.9 Parameter Adaptation

The Contractor shall provide a master set of parameters that can be used at all MIAWS equipped airports. The Contractor shall propose for Government approval at the CDR the master adaptation parameter set as described in FAA-E-2950 section 3.1.4.4.1.

Each parameter shall: be uniquely designated, contain the unit of measure in which the parameter is stated, identify the increments to which the parameter can be set, and state the adaptable range of values within which the parameter may be set. The Contractor shall provide an initial setting of each parameter from where the optimized parameter setting can be established during installation.

3.2.10 Technical Reviews

The Contractor shall conduct the following technical reviews:

a. Preliminary Design Review (PDR)
b. Critical Design Review (CDR)

Technical presentations shall be based upon the Contractor's system/subsystem engineering efforts and related documentation. At each review, the Contractor shall be prepared to provide back-up data on assumptions made and methodologies used in arriving at specific recommendations/conclusions for the design approach. The Contractor shall make available for reference and inspection at the reviews: applicable engineering data, specifications, drawings, schematics, design and test documentation, software development files, schedules, and working papers and results of studies and analyses.

There shall be a free exchange of ideas between the Contractor and the Government at the formal reviews in order to establish program progress, identify technical problems, and resolve problems in a timely manner. Key Contractor personnel shall be available to respond to Government questions.

The Contractor shall notify the CO of readiness for a review at least 20 calendar days in advance of the planned start of each review. If documents required for a review have not been delivered to the Government as scheduled, or if the content of the delivered documents is not adequate to support the review, the Government shall have the option of postponement without prejudice to other contractual requirements.

The Contractor shall prepare and submit to the Government an agenda, presentation materials, and minutes for all technical reviews. The minutes shall include action items resulting from the review with planned closure dates, responsible person(s), planned action(s) to resolve, and any Government action(s) required. The status of each open action item shall be reviewed at PMRs until approved by the Government and closed.

CDRL: A003 Agenda
CDRL: A004 Presentation Materials
CDRL: A005 Meeting Minutes

3.2.10.1 Technical Review Instructions

The following instructions apply to all technical reviews:

a. Presentations shall be conducted by Contractor personnel, although the Government reserves the right to revise the agenda and/or make presentations.

b. Reviews shall be held at the Contractor's facility unless changed by mutual agreement between the Government and Contractor.

c. The Contractor shall assume all responsibility for recording action items.

d. Response to all assigned action items by either closure or a plan for closure shall be made by the Contractor to the Government in the minutes of the meeting/reviews. The status of all action items shall be tracked

at the PMRs and provided in writing as part of the PMR minutes until the action item has been resolved as mutually agreed by the Government and Contractor.

e. Ten working days after receipt of the review/audit minutes, the Government will formally notify the Contractor of the results of the subject review/audit by:

   ?? Approval - to indicate that the review/audit was completed satisfactorily;

   ?? Contingent Approval - to indicate that the review/audit is not considered complete until completion of specific action items to the Government's satisfaction;

   ?? Disapproval - to indicate that the review/audit was not satisfactory, and to identify those areas that were deficient. The Contractor shall have 15 working days to respond to the Government and provide a plan to complete the review/audit and maintain the program schedule.

Formal reviews shall not be considered complete until approval by the Government is granted in writing.

3.2.10.2 Preliminary Design Review

After all necessary CDRLs are approved by the Government, the Contractor shall conduct a PDR. This review shall be conducted for each CI or aggregate of CIs to:

a. Evaluate the progress, technical adequacy, and risk resolution (on a technical, cost, and schedule basis) of the selected design approach;

b. Evaluate the degree of definition and assess the technical risk associated with the selected manufacturing methods/processes; and

c. Establish the existence and compatibility of the physical and functional interfaces among the CIs and other items of equipment, facilities, computer software, and personnel.

For CSCIs, this review shall focus on:

a. The evaluation of the progress, consistence, and technical adequacy of the selected top-level design and test approach;

b. The compatibility between software requirements and preliminary design; and

c. For each HWCI and CSCI, identify which requirements are satisfied by COTS, which requirements are already implemented, but require modification, and which requirements require development.

The PDR shall cover the preliminary design of all hardware and software CIs. For items that are not Contractor-developed, the Contractor shall provide a

functional/physical description of the item, the results of the analysis that verifies the item will meet the associated technical requirements, and a description of the interfaces with other CIs and Contractor-developed software.

At the PDR, the Contractor shall describe the products, processes, methodologies, milestones, and measurements to be used in conducting software development activities. The Contractor shall describe its plans for acquiring and developing the required software to meet contract requirements. The Contractor shall identify the proposed programming language.

Overall technical program risks shall be reviewed on a technical, cost, and schedule basis.

As part of the PDR, the Contractor shall present and review the following items with the Government:

a. System overview and basic design approach for each CI that shows that MIAWS uses an open architecture to ensure modularity and scalability;

b. Functional flow, requirements allocation and schematic diagrams;

c. All CI to CI interfaces;

d. Physical description including preliminary lists of materials;

e. Reliability and Maintainability Analysis and Predictions (see Section 3.2.8);

f. Adaptation parameter set (see Section 3.2.9);

g. Results of tradeoffs;

h. Proposed test equipment;

i. CI development schedule;

j. Quality Assurance overview;

k. Documentation status;

l. Data that demonstrates the system’s 20 year durability;

m. How an Uninterruptable Power Supply can be accommodated by proposed design, if necessary;

n. Definition of system constraints (size, power requirements, etc.) for the Government to do site preparation at the William J. Hughes Technical Center (WJHTC).

o. Test data from any proposed COTS items;

p. Review of technical action items;

q. Use and integration of the GFP software; and

r. Test program overview.

CDRL: A003 Agenda
CDRL: A004 Presentation Materials
CDRL: A005 Meeting Minutes

3.2.10.2.1 PDR Acceptance Criteria

The PDR acceptance criteria are as follows. To successfully complete PDR, the Contractor shall:

a. Provide a traceability of the requirements baseline to the HWCIs and CSCIs.

b. Present a preliminary design that shows how COTS, modified COTS, and new development will work together to satisfy the requirements baseline.

c. Provide approved CDRLs that are associated with PDR.

d. Satisfy SOW requirements in section 3.2.10.2.

e) Provide deliverables that are acceptable to the Government of the following:

- First submittal System Design Document (B001)
- First submittal ICDs (B002)
- First submittal Software Development Plan (B003)
- System Requirements Spec (B004)
- Configuration Management Plan (C002)

3.2.10.3 Critical Design Review

The Contractor shall conduct a CDR after the PDR is approved by the Government and all PDR action items are closed, unless the Government has given permission to proceed. This review shall be conducted for each CI when detailed design is essentially complete. The purpose of this review shall be to:

a. Evaluate, in detail, the progress, technical adequacy, and risk resolution (on a technical, cost, and schedule basis) of the selected design approach;

b. Evaluate, in detail, the degree of definition and assess the technical risk associated with the selected manufacturing methods/processes;

c. Establish the detailed design completeness and compatibility among the CI and other items of equipment, facilities, computer software and personnel; and

d. Present a detailed design that shows how COTS, modified COTS, and new development will work together to satisfy the requirements baseline.

The CDR shall cover the detailed design of all Contractor-developed hardware and software CIs. For items that are not Contractor-developed, the Contractor shall provide a detailed functional/physical description of the item, any additional results since the PDR of the analysis that verifies the item will meet the associated technical requirements, and a detailed description of the interfaces with other CIs.

The Contractor shall provide further details, than were presented at PDR, of its plans for acquiring and developing the required hardware and software to meet contract requirements.

Overall technical program risks shall be reviewed on a technical, cost, and schedule basis.

As part of the CDR, the Contractor shall present and review in detail the following items with the Government:

a. System overview and basic design approach for each CI that shows that MIAWS uses an open architecture to ensure modularity and scalability;

b. Functional flow, requirements allocation and schematic diagrams;

c. All CI to CI interfaces;

d. Physical description including preliminary lists of materials;

e. Reliability and Maintainability Analysis and Predictions (see Section 3.2.8);

f. Adaptation parameter set (see Section 3.2.9);

g. Results of tradeoffs;

h. Proposed test equipment;

i. CI development schedule;

j. Quality Assurance overview;

k. Documentation status;

l. Data that demonstrates the system’s 20 year durability;

m. Conceptually how pre-planned product improvements in FAA-E-2950 section 1.4 can be accommodated by proposed design;

n. How an Uninterruptable Power Supply can be accommodated by proposed design, if necessary;

o. Definition of system constraints (size, power requirements, etc.) for the Government to do site preparation at the WJHTC;

p. Use and integration of the GFP software; and

q. Test program overview.

CDRL: A003 Agenda
CDRL: A004 Presentation Materials
CDRL: A005 Meeting Minutes

3.2.10.3.1 CDR Acceptance Criteria

The CDR acceptance criteria are as follows. To successfully complete CDR, the Contractor shall:

a. Provide approved CDRLs that are associated with CDR.

b. Satisfy SOW requirements in section 3.2.10.3.

c. Establish an initial allocated baseline based on the detailed design.

d. Provide deliverables that are acceptable to the Government of the following:

- System Design Document (B001)
- Interface Control Documents (B002)
- Software Development Plan (B003)
- First submittal Software Design Description (B005)

3.2.10.4 Technical Interchange Meetings

The Contractor shall conduct and administratively support TIMs at the Contractor's facility. TIMs shall be conducted once per month. During the TIMs, the Contractor and the Government will discuss specific technical activities, including studies, test plans, test results, design issues, technical decisions, and implementation concerns. An overview of action items shall be included.

As part of the first TIM, the Contractor shall present:

a. An understanding of Specification FAA-E-2950, system interfaces, and SOW requirements;

b. Functional flow analysis and preliminary requirements allocation;

c. Program risk analysis, including assumptions, trade-offs and alternative approaches;

d. Identification of design-driving/cost-driving requirements;

e. Configuration Management (CM) overview; and

f. Test program overview.

CDRL: A003 Agenda
CDRL: A005 Meeting Minutes

3.2.11 Program Trouble Report

The Contractor shall implement a system to identify, report, monitor, and resolve all hardware, firmware, and software problems. The Contractor shall include all problems identified by both the Contractor and the FAA, and those identified by other users that have an impact on the system functionality. Tracking of Program Trouble Reports (PTRs) shall begin at the start of the Design Qualification Tests (section 3.10.3.4). The Contractor shall maintain the GFE PTR database in which each failure or problem (hardware and software) discovered is fully documented using a GFE PTR format. The PTR database shall maintain the master copy of all PTRs. The Contractor shall provide the PTR database as a part of electronic on-line access to authorized FAA personnel (read only mode).

As part of the CM Plan, the Contractor shall describe how a configuration control board shall be used to open, track, and close PTRs. The Government will have the opportunity to participate in the Contractor’s PTR configuration control board. The Contractor shall give the Government at least five (5) working days notice prior to a configuration control board meeting.

CDRL: C001 Program Trouble Report

3.2.12 Action Items

The Contractor shall implement a system to identify, report, monitor, and resolve all action items. The Contractor shall include all action items identified by both the Contractor and the FAA. The Contractor shall formally track all action items from PMRs, TIMS, and technical reviews through resolution. The Contractor shall provide the current status of all action items with the minutes of all management and technical reviews.

3.3 Configuration Management Program

The Contractor shall establish and maintain a CM program using FAA Order 1800.66 and FAA-STD-021 in their entirety that shall provide an organizational structure with configuration identification and control methods, and configuration status accounting procedures for hardware and software. The Contractor shall identify the single focal point that will serve as the primary point of contact for all communication on CM-related issues.

3.3.1 Configuration Management Plan

The CM program shall be documented in the CM Plan, which shall include a description of how the Contractor’s CM program is organized, how it will be conducted, and the methods, procedures and controls used to assure effective configuration, identification, change control, and status accounting of the total configuration, including hardware, software and firmware.

CDRL: C002 Configuration Management Plan

3.3.2 Configuration Control

The Contractor shall maintain configuration control of hardware, software, firmware, and developmental/commercial documentation. The Contractor shall maintain configuration control of the hardware to the Lowest Replaceable Unit (LRU) Level and software to the version level.

3.3.2.1 Developmental Configuration

The Contractor shall use an internal developmental CM system. The documentation and repositories for this developmental configuration shall remain the Contractor’s responsibility until the MIAWS system is accepted by the Government.

3.3.2.2 Configuration Identifiers

The Contractor shall assign unique configuration identifiers.

3.3.2.3 Part/Item Identification Numbers

The Contractor shall assign a discrete part/item identification number until such time as either an interim or final product baseline is established. At that point, parts shall be re-identified only upon Government approval whenever a non-interchangeable condition is created.

3.3.2.4 Software Identification Number

The Contractor shall assign a discrete part/identification number to each software medium, (e.g., magnetic disk, tape) containing release or build type software executables. The medium thus identified shall be inclusive and contain all software segments, thereby providing easy identification of software releases after the product baseline is established.

3.3.2.5 FAA Type Designations

The Contractor shall request unique FAA equipment type designations based upon an engineering and logistical review of structural or hardware items that could be advantageously identified by means of an FAA type number. FAA designations normally consist of two alpha characters in combination with five numeric (e.g., FA-85000) that shall be affixed to the unit on the nameplate in a location where it is readable, if practical, when the unit is in service IAW FAA-G-2100 paragraph 3.3.3 and subparagraphs. FAA type designations shall not be assigned nor affixed to equipment that has been procured to specifications of other Government agencies or previous FAA procurements and that have already been assigned their own type designations or model numbers, unless a “major modification” is applied to the equipment based upon the MIAWS design. FAA type designations are applicable to developmental and COTS items. The FAA type designation nameplate shall not invalidate any warranty or equipment operation. Consideration shall be given to adhesive attachment of the FAA type number nameplate for COTS items.

3.3.2.6 Parts Substitutions

The Contractor shall maintain parts substitution control.

3.3.3 Change Control

3.3.3.1 Engineering Change Request, Deviation, Waiver

The Contractor shall implement an effective engineering change control program. The Contractor shall seek CO concurrence prior to submitting Class I changes. Upon receiving concurrence from the CO, the Contractor shall formally submit an Engineering Change Request (ECR) for review and approval for Class I changes IAW MIL-STD-973. Submittal of ECRs shall begin at the start of formal test.

The Contractor shall submit deviation requests prior to the manufacture of a hardware item that would incorporate a known departure from requirements. Deviations shall be submitted only for temporary departures from requirements, shall be for less than the production quantity of the item, and shall not involve changes to any MIAWS baseline documentation.

The Contractor shall submit waiver requests after the manufacture of a hardware item that contains a departure from known requirements and the Contractor proposes that the Government accept the item “as is”. Waivers shall be submitted only for specifically identified items of less than the production quantity of that item, and shall not involve changes to any MIAWS baseline documentation.

CDRL: C003 Engineering Change Request, Deviation, Waiver

3.3.4 Bar Coding Marking

Each package, replaceable item, and its container shall be marked and bar coded, IAW FAA-BCATS-96-001. The Contractor shall mark all LRUs and LRU spares with bar code symbology IAW FAA-BCATS-96-001.

CDRL: C004 LRU Bar Code Identification Report

3.3.5 System Baseline

A configuration product baseline for software and hardware shall be established prior to the start of the Design Qualification Tests (section 3.10.3.4). A Configuration Status Accounting Report shall be delivered with the first unit documenting the baseline in contractor format. All changes made after the baseline is established shall be done through the ECR described in section 3.3.3.1.

CDRL: C005 Configuration Status Accounting Report

3.4 Logistics

The Contractor shall maintain the system until Government acceptance of the system and shall satisfy the availability and reliability requirements in FAA-E-2950.

3.4.1 Packaging, Handling, Storage, and Transportation

The packaging, handling, storage, and transportation of the MIAWS shall be IAW FAA Order 1800.58.

3.5 Security

3.5.1 Infrastructure

MIAWS Infrastructure Security shall comply with Presidential Decision Directive 63 and Office of Management and Budget (OMB) Circular A-130.

3.5.2 NAS Information Security

MIAWS NAS Information Security shall be IAW with FAA Order 1370.82, Department of Transportation (DOT) H 1350, and DOT H 1350.251.

3.5.3 Personnel Security

MIAWS Personnel Security shall be IAW FAA Order 1600.1.

3.6 Quality

3.6.1 Quality Assurance

The Contractor shall establish and maintain a documented quality system IAW their company's quality manual and the Quality System Plan (QSP). A QSP shall be prepared IAW CDRL B003 and approved by the Government. The QSP shall be modified during the life cycle of the contract when necessary. The Contractor shall require that sub-tier suppliers maintain a similar quality system for achieving quality control of services and supplies provided. All spare parts must be inspected and tested in plant, using the same procedures as the primary equipment components.

CDRL B008 Quality System Plan

3.6.2 Quality Assurance Audits & Inspections

In addition to its own in-house quality audits, inspections and tests, the Contractor shall cooperatively allow and perform random quality audits, inspections and/or tests IAW ISO standards and at the determination of the Government. A TIM shall be conducted prior to conduct of such activities. The TIM minutes, CDRL A005, shall be used to document the agreed to scope of the activity and to identify the objectives and any other pertinent information required to conduct the inspections. These inspections shall not require the preparation of formal inspection plans or procedures. The Contractor shall be prepared to show internal test and quality documentation at these inspections. Any results of non-compliance or unexplainable

anomalies shall be entered into the Contractor’s problem reporting system as a PTR, CDRL C001, and shall be formally tracked until resolution. The Government may require the audits and inspections at any time during this contract period.

CDRL A005 Meeting Minutes
CDRL C001 Program Trouble Report

3.7 Safety

3.7.1 Handling

Handling of hazardous materials shall be IAW the 29 Code of Federal Regulations (CFR) 1910, *Occupational Safety and health Standards*, and FAA Order 8040.4.

3.7.2 Material Safety Data Sheets

Material Safety Data Sheets shall be submitted for each MIAWS hazardous material supplied.

3.7.3 Hazard Identification Process

A safety risk assessment for the MIAWS shall be conducted IAW FAA Order 8040.4.

3.8 Life Cycle

Human factors integration shall be IAW the FAA's Human Factors Job Aid and FAA Order 9550.8.

3.9 Employee Safety and Health

MIAWS shall be IAW FAA-G-2100; FAA Order 3900.19, FAA Order 1050.17; and Occupational Safety and Health Administration (OSHA), 29 CDR 1925.

3.10 System Test and Evaluation

The Contractor shall establish a formal test program. The test and inspection program shall be designed to verify the requirements specified in the MIAWS Specification (FAA-E-2950) and related specifications/standards. All formal testing shall be conducted on a test article that exactly conforms to the configuration established in section 3.3.5. The test program shall verify that the MIAWS system and its support elements meet the physical, functional, interface, and performance requirements, as stated in the MIAWS specification (FAA-E-2950), in the intended environment, and with the intended users.

The Contractor shall develop test schedules, test plans, and test procedures to meet the CDRL requirements of this SOW. If available, the Contractor may use draft test plans and procedures from MIT/LL as a guide. The Contractor shall conduct tests and generate test reports, as required by this SOW. The Contractor shall integrate test schedules into the overall MIAWS program schedule. The Government reserves the right to witness Contractor testing

during any test phase or level. The Contractor shall furnish equipment, space, and personnel required to perform Contractor-conducted factory tests. The Contractor shall coordinate testing to be performed, and ensure that there is minimal redundancy of effort or data. The Contractor shall have the responsibility for integration, control, and coordination of Contractor and subcontractor testing and support of Government testing. The Contractor shall notify the Government of testing schedules at least five (5) working days prior to the start of each test. Contractor-proposed test tools, documentation, and test-support hardware and software shall be approved by the FAA prior to the start of testing. The Contractor shall provide facilities and equipment required for successful completion of required tests. The Contractor's test program shall include all requirements identified in the GFE TVRTM.

3.10.1 Contractor Master Test Plan

The Contractor shall prepare, update, and maintain the Contractor's Master Test Plan (CMTP), which shall serve as the overall test control document for the Contractor's MIAWS Test Program. The Contractor shall plan, conduct, and document an integrated test and evaluation program, in conformance with this SOW and the Government CMTP using the FAA Acquisition Management System Test & Evaluation Process Guidelines (AMST&EPG).

The Contractor shall complete the GFE TVRTM by mapping each TVRTM requirement to one of the Contractor-performed formal tests specified in this SOW. In addition, the Contractor shall identify the test verification method to be utilized in verifying each of these mapped requirements. Verification methods include the following:

- Inspection- Requirements verification by inspection shall determine specification compliance through visual observation, software design verification, measurements, review of source code, physical location, or examination of/comparison to documents (e.g. Software Design Document, User's Manuals), standards, etc. and requiring inspection procedures, data collection, and pre-defined success criteria.

- Analysis- Requirements verification by analysis shall determine specification compliance by the accumulation of data and the use of data reduction and statistical techniques, such as extrapolation, interpolation, and probabilities, to determine if the particular requirement has been satisfied. Examples of this would be to accumulate weeks of system up/down time data and then by performing data reduction and statistical analysis determine if the Mean Time Between Critical Failure (MTBCF) and Availability requirements of the system have been achieved. Another type of analysis is the comparison of applicable aspects of the Subsystem design with known, established, and certified (or certifiable); technical data, scientific/technical principles, procedures and/or practices which validate the requirement and require analysis procedures and pre-defined success criteria.

- Demonstration – Requirements verification by demonstration shall determine specification compliance by direct observation, usually via a

terminal and/or monitor. No interpretation of the displayed information is involved, rather a qualitative assessment is made.

?? Test- Requirements verification by test shall determine specification compliance by a repeatable method of verification of specification requirements that entails the use of specific input(s) and wholly predictable, unique, and specific output(s) (quantitative results). A test may comprise a number of cases, each of which entails provision of specific input(s) and subsequent comparison of the result/output(s), processing with the expected specific result/output(s). Data acquired during a test may be subject to reduction and analysis in order to validate the results against a pre-defined success criteria.

All testable requirements shall be allocated to at least one of the test categories defined in this section. Each formal test shall have success criteria defined in the test plan for each testable requirement being verified. Each test shall be conducted on a pass/fail basis. The pass/fail criteria shall provide a clear and unambiguous objective for the determination of test success or failure. A test shall be considered complete when the test has been executed without aborts or errors (unless it is part of the test procedure) and when all analyses have verified correct operation IAW approved plan methods and the specified success criteria. Each test shall be capable of being repeated and achieve the same results. Discrepancies between actual and expected test results shall be explained by analysis of test data.

The CMTP shall be the primary document for describing the plans and processes of Design Qualification Testing (DQT). Activities such as software unit testing, software integration testing, and software/hardware integration testing shall be documented in detail. The process for testing the incremental development of the algorithms, software, and hardware into a functioning MIAWS system shall be described in detail. The CMTP shall also include a description on the utilization of Software Development Folders (SDFs) to document DQT testing, including discrepancies.

CDRL: E001 Contractor’s Master Test Plan

3.10.2 Test and Evaluation Management

The Contractor shall assign a Test Manager with responsibility for integration, control, oversight, and coordination of all Contractor and subcontractor testing. The Contractor’s Test Manager shall coordinate all Contractor testing to be performed and shall ensure there is no discrepancy of effort or data. The Test Manager shall have no other responsibilities. The Test Manager shall ensure that any test personnel involved with the planning (developing plans or procedures) or conduct of formal testing, have no other responsibilities under this contract.

3.10.2.1 Test Readiness Reviews

The Contractor shall schedule and conduct a Test Readiness Review (TRR) prior to initiating any formal test phase. The agenda for the TRR shall be presented to the Government at least 5 working days prior to the meeting. This TRR shall be utilized by the Government to assess the Contractor’s

readiness to begin formal testing. The Contractor shall provide a final test product (plan and/or procedures) that incorporates all previous Government comments at least five working days prior to conducting this review. During this TRR, the Contractor shall provide a schedule for conducting tests, and identify any pre-requisite requirements for conducting these tests. At the conclusion of the TRR, the Contractor shall not proceed into formal test without prior Government approval.

3.10.3 Development Test

The Contractor shall perform Development Test (DT). The purpose of DT shall be primarily to assist in the engineering design and development and implementation process by determining incrementally the degree to which functional engineering specifications are attained. In general, DT shall consist of DQT, Formal Qualification Testing (FQT), FAT, Site Acceptance Testing (SAT), and Delta DT as defined below. The Contractor shall develop a single System Test Plan (STPl) document for FQT, FAT, SAT, and Delta DT. The Contractor shall develop a single System Test Procedures (STPr) document for FQT, FAT, SAT, and Delta DT. The STPl and the STPr must be formally approved by the Government prior to the start of any formal test. The Contractor shall develop System Test Reports for FQT/FAT, SAT, and Delta DT. SAT shall be conducted at the WJHTC prior to Delta DT to ensure proper installation.

DQT and FQT shall include incremental algorithm verification tests to validate all GFP algorithms. The purpose of the tests shall be to establish points within the Contractor’s software development process in which to verify the integration of various algorithms and support components into a functioning MIAWS system. Incremental algorithm testing is crucial and will ensure that the GFP algorithms have been successfully integrated into the software, and operate correctly at a system level.

Each formal Test Phase including FQT, FAT, SAT, and Delta DT shall not be considered successfully completed until:

?? The Government representative has witnessed the actual test;
?? The test is conducted to the Government representative’s satisfaction that the test was conducted IAW the Government approved plan and procedures;
?? The test results, including all data analysis, the test report, and corrective actions, have been completed to the satisfaction of the Government representative and approved by the Government;
?? All documentation associated with the system has been updated to reflect changes made during testing; and
?? All PTRs have been resolved and all changes made as a result of the PTR have been approved.

3.10.3.1 Developmental Test and Evaluation Briefing

The Contractor shall conduct an informal DT Training and Familiarization Briefing, at the WJHTC, to enable Government personnel to assess DT test activities. DT Briefings shall be conducted in time to permit Government personnel to witness and understand Contractor DT activities. Briefing attendance will be approximately 5 to 10 students.

3.10.3.2 Dry Run Tests

The Contractor shall conduct a formal dry-run test for each test phase identified in the CMTP or STPl. These tests shall be conducted IAW this SOW and the applicable approved test plan and test procedures. Following the completion of each test, the Contractor shall prepare and deliver an informal report, and receive Government approval of the redlined test procedures prior to proceeding into the applicable formal test. The Contractor shall provide dry run data to the Government 15 working days prior to the start of the associated TRR.

3.10.3.3 Requirement Discrepancy Reporting an Regression Testing

The Contractor shall utilize the GFE PTR database. A Contractor-developed database may be substituted for the GFE PTR database upon Government approval. Discrepancies encountered during any test phase shall be reported. PTRs shall include regression testing plans, procedures, and results. Revised test plans and procedures shall be submitted for Government review and approval at least five working days prior to planned regression testing. For COTS and GFE hardware/software, the Contractor shall record problems and perform regression testing IAW this section.

The Contractor shall be responsible for all corrective action necessary to ensure full specification compliance. The Contractor shall complete all repairs or rework prior to submission for regression testing. The Government Test Director will determine the extent of regression testing required. No formal regression testing shall be commenced until the Contractor has submitted in writing all information concerning the non-compliance and the corrective action taken, and the Government Test Director agrees to start the regression testing. If a review of the reasons for failure to comply with MIAWS specification (FAA-E-2950) requirements indicates that the cause may exist as latent defects in items previously accepted, the Contractor shall be responsible to correct the defects in all units in a timely manner, even those previously accepted by the Government. The Contractor shall re-verify, by the verification method identified in the TVRTM, that the defect(s) have been corrected.

3.10.3.4 Design Qualification Tests

Contractor shall conduct DQTs at the Contractor’s MIAWS Test Facility. DQT shall be conducted during the development process and shall include software unit testing (new modules only), software integration testing, and software/hardware integration testing. DQT shall be conducted IAW with the CMTP. The CMTP shall describe the detailed plans and processes for conducting DQT. DQT shall include low level testing of any new software modules. DQT shall include boundary limit testing of variables. DQT shall include stress testing of all new modules.

The Contractor shall perform DQT to verify that the implemented design meets functional and performance requirements of the MIAWS specification (FAA-E-2950) and this SOW. The Contractor shall provide the Government five working days advance notice of all major DQT. An authorized Government representative may witness DQT. DQT test results shall be documented in an official test

log. Discrepancies found during DQT shall be reported, in detail, in the SDFs.

CDRL: E001 Contractor's Master Test Plan

3.10.3.4.1 Algorithm Implementation

The Contractor shall plan for and conduct incremental algorithm verification tests during the course of the DQT software development period. The purpose of the tests shall be to establish points within the Contractor's software development process in which to verify the integration of various algorithms and support components into a functioning MIAWS system.

The Contractor shall utilize GFE base data and time series data as test data and shall compare the resulting algorithm outputs with corresponding Government-supplied correct outputs. The Contractor shall analyze the results of this comparison test to determine the performance of the system on the test data cases.

3.10.3.5 Formal Qualification Tests

The Contractor shall perform Formal Qualification Tests (FQTs) to verify that the implemented design meets functional and performance requirements of the MIAWS specification (FAA-E-2950) and this SOW. The Government will witness FQT. The Contractor shall employ GFE software test data and post-conduct analysis to verify that the software developed implements the GFP meteorological and display algorithms correctly. FQT shall include system-level stress testing. The FQT test plan shall be documented in the STPl. The FQT test procedures shall be documented in the STPr.

The Contractor shall report discrepancies using the GFE PTR database. The Contractor shall be responsible for correcting and retesting all identified discrepancies or otherwise resolving the discrepancies with the Government designated representatives. The tests shall verify that the developed software meets TVRTM requirements. The Contractor shall verify the continued functional requirement compliance of the software for any platform upgrade through regression testing. Results of FQT shall be reported in the FQT/FATSTR. Discrepancies found during FQT shall be reported through the GFE PTR database, with each discrepancy having a unique report.

CDRL: E002 System Test Plan
CDRL: E003 System Test Procedures
CDRL: E004a FQT/FAT System Test Report

3.10.3.5.1 Algorithm Implementation

The FQT algorithm verification test procedures shall be documented in the STPr. The algorithm test case data will include input data and the expected resultant data for each algorithm and will be different in weather content from the data supplied to the Contractor for DQT. The Contractor shall compare the resulting algorithm outputs with the corresponding Government supplied expected results. The Contractor shall analyze the results of the comparison to determine the correctness of the software on the test case data.

3.10.3.6 Factory Acceptance Tests

The Contractor shall perform factory acceptance testing (FAT) to ensure that the complete, integrated system meets all TVRTM requirements. The Contractor shall perform FAT at the Contractor's facility to verify that it meets all functional and performance requirements and is free from manufacturing defects. The Contractor shall conduct a full FAT system requirements verification, using the GFE TVRTM. FAT shall include stress testing of the complete, integrated system during the Free Play test. The Government will witness FAT. The FAT test plan shall be documented in the STPl. The FAT test procedures shall be documented in the STPr. Results of FAT shall be documented in the FQT/FAT STR.

The Contractor shall report discrepancies using the GFE PTR database. The Contractor shall be responsible for correcting and retesting all identified discrepancies or otherwise resolving the discrepancies with the Government designated representatives. The tests shall verify that the developed software meets TVRTM requirements. The Contractor shall verify the continued functional requirement compliance of the software for any platform upgrade through regression testing. Discrepancies found during FAT shall be reported through the GFE PTR database, with each discrepancy having a unique report.

CDRL: E002 System Test Plan
CDRL: E003 System Test Procedures
CDRL: E004a FQT/FAT System Test Report

3.10.3.6.1 Free Play Tests

The Contractor shall conduct a continuous system test for 72 hours. This test shall utilize pre-planned scripts approved by the Government. A portion of these scripts shall be used to stress the system. A segment of the test may be conducted without scripts.

The Contractor shall allow time for Government conducted testing. The Government conducted testing will be pre-planned. An informal test plan will be submitted to the Contractor for review no later than 2 weeks prior to FAT and will be finalized at TRR. The Contractor shall provide support to this Government testing when needed.

The Contractor shall report discrepancies using the GFE PTR database. The Contractor shall be responsible for correcting and retesting all identified discrepancies or otherwise resolving the discrepancies with the Government designated representatives. The tests shall verify that the developed software meets TVRTM requirements. The Contractor shall verify the continued functional requirement compliance of the software for any platform upgrade through regression testing. Discrepancies found during Free Play Tests shall be reported through the GFE PTR database, with each discrepancy having a unique report.

3.10.3.7 Site Acceptance Tests

The Contractor shall conduct a Site Acceptance Test (SAT) for the installed MIAWS System. The Contractor shall ensure that the system being installed at WJHTC is the same system that was successfully (i.e., Government approved) FAT

tested at the Contractor's facility and is baselined under Configuration Management. The Contractor shall provide tests for those requirements unique to the MIAWS operational environment (e.g., stress, loading, live interfaces) at the WJHTC. The Contractor shall also implement tests for those site-specific requirements related to installation at the WJHTC. The SAT test plan shall be documented in the STPl. The SAT test procedures shall be documented in the STPr. Results of SAT shall be documented in the SAT STR.

The Contractor shall report discrepancies using the GFE PTR database. The Contractor shall be responsible for correcting and retesting all identified discrepancies or otherwise resolving the discrepancies with the Government designated representatives. The tests shall verify that the developed software meets TVRTM requirements. The Contractor shall verify the continued functional requirement compliance of the software for any platform upgrade through regression testing. Discrepancies found during SAT shall be reported through the GFE PTR database, with each discrepancy having a unique report.

CDRL: E002 System Test Plan
CDRL: E003 System Test Procedures
CDRL: E004b SAT System Test Report

3.10.4 Delta DT Tests

The Contractor shall perform Delta DT testing to satisfy those test requirements that require an operational environment not available at the Contractor's facility. These tests shall be run at the WJHTC to ensure that the system does not degrade external systems. Delta DT tests shall be conducted on the system that satisfactorily passed FAT at the Contractor's facility and SAT at the WJHTC. The Delta DT test plan shall be documented in the STPl. The Delta DT test procedures shall be documented in the STPr. Results of Delta DT shall be documented in the Delta DT STR.

The Contractor shall report discrepancies using the GFE PTR database. The Contractor shall be responsible for correcting and retesting all identified discrepancies or otherwise resolving the discrepancies with the Government designated representatives. The tests shall verify that the developed software meets TVRTM requirements. The Contractor shall verify the continued functional requirement compliance of the software for any platform upgrade through regression testing. Discrepancies found during Delta DT shall be reported through the GFE PTR database, with each discrepancy having a unique report.

CDRL: E002 System Test Plan
CDRL: E003 System Test Procedures
CDRL: E004c Delta DT System Test Report

3.10.4.1 Interface Tests

As part of Delta DT, the Contractor shall perform the following interface tests:

- The Contractor shall demonstrate that the MIAWS can interface and operate compatibly with the external interfaces defined in the MIAWS specification (FAA-E-2950).

- ?? The Contractor shall demonstrate that the MIAWS can interface and operate compatibly with the displays in the worst-case configuration (e.g., maximum line lengths and modem configurations). A test pattern shall be provided that facilitates evaluating line width, resolution, color palette, and intensity.

These tests shall utilize the maximum number of interfaces and functions as facility operational requirements permit.

3.10.5 Test Equipment

The Contractor shall be responsible for assuring that necessary test equipment is available, on time, properly calibrated, and fully operational to support tests. Use of Government test equipment may be permitted where Government test equipment is on site, is available, and meets specified test equipment requirements. Test equipment used by the Contractor during Factory or Site Tests shall be standard commercial equipment and shall not be modified without prior written approval of the FAA. Test equipment shall operate in the manner specified by the test equipment manufacturer. The Contractor for the duration of the tests shall furnish ancillary equipment required by the Contractor for test purposes. The Government Test Director may require the Contractor to re-calibrate any test equipment provided by the Contractor to be used in the test program due to the following:

- ?? The test equipment is removed from the test set-up for unrelated purposes.
- ?? The test equipment fails, is damaged, or appears to be operating in a faulty manner based on Government evaluation of test results.

3.10.6 Operational Capabilities Test

Once Delta DT is approved, the Government will conduct an Operational Capabilities Test (OCT). The Contractor shall support OCT. This shall include engineering and field support sufficient to operate, maintain, and support the MIAWS during all operational test activities. The Contractor shall provide staff dedicated to supporting OCT.

3.11 Delivery, Installation and Checkout

3.11.1 Delivery of MIAWS Unit

The Contractor shall deliver, off-load, install, and check-out the MIAWS specified under this contract at the WJHTC. This shall include, but is not limited to, the MIAWS mounting hardware, mounting racks, conduit, ductwork, cables, and wiring required for all installation work, and interconnecting cables.

3.12 Engineering Services

The Contractor shall provide engineering support as directed by the CO. These services shall be performed by: 1) Engineers(s) who have participated in and are knowledgeable with the equipment’s design, integration and installation; and 2) a Software Engineer who has first hand knowledge of the delivered software.

4.0 GLOSSARY

AMST&EPG	Acquisition Management System Test & Evaluation Process Guidelines
ASR	Airport Surveillance Radar
ATC	Air Traffic Control
ATCT	Air Traffic Control Tower
BMIPS	Baseline Master Integrated Project Schedule
CDR	Critical Design Review
CDRL	Contract Data Requirements List
CI	Configuration Item
CM	Configuration Management
CMTP	Contractor's Master Test Plan
CO	Contracting Officer
COTS	Commercial-Off-The-Shelf (COTS)
CPCI	Computer Program Configuration Item
CSCI	Computer Software Configuration Item
DID	Data Item Descriptions
DODSSP	Department of Defense Single Stock Point
DQT	Design Qualification Test
DT	Developmental Test
ECR	Engineering Change Request
FAA	Federal Aviation Administration
FAT	Factory Acceptance Testing
FQT	Formal Qualification Test
GFE	Government Furnished Equipment
GFI	Government Furnished Information
GFP	Government Furnished Property
HWCI	Hardware Configuration Item
IAW	In Accordance With
ICD	Interface Control Document
IDD	Interface Design Document
IEEE	Institute of Electrical and Electronics Engineers
IRD	Interface Requirements Document
LRU	Lowest Replaceable Unit
MIAWS	Medium Intensity Airport Weather System
MIT/LL	Massachusetts Institute of Technology/Lincoln Laboratories
MTBCF	Mean Time Between Critical Failure
NDI	Non-Developmental Items
NEXRAD	Next Generation Weather Radar
OCT	Operational Capabilities Test
OSHA	Occupational Safety and Health Administration
PDR	Preliminary Design Review
PM	Program Manager
PMP	Program Management Plan
PMR	Program Management Review
PROM	Programmable Read Only Memory
PSR	Project Status Report
PTR	Program Trouble Report
QSP	Quality System Plan
ROM	Read Only Memory

SAT	Site Acceptance Testing
SDD	System Design Description
SDF	Software Development Folder
SDP	Software Development Plan
SEMP	Systems Engineering Management Plan
SIR	Screening Information Request
SoDD	Software Design Description
SOW	Statement of Work
SRS	Software Requirements Specification
STPl	System Test Plan
STPr	System Test Procedures
TDWR	Terminal Doppler Weather Radar
TIM	Technical Interchange Meeting
TRACON	Terminal Radar Approach Control Area
TRR	Test Readiness Review
TVRTM	Test Verification Requirements Traceability Matrix
WBS	Work Breakdown Structure
WJHTC	William J. Hughes Technical Center
WSP	Weather Systems Processor